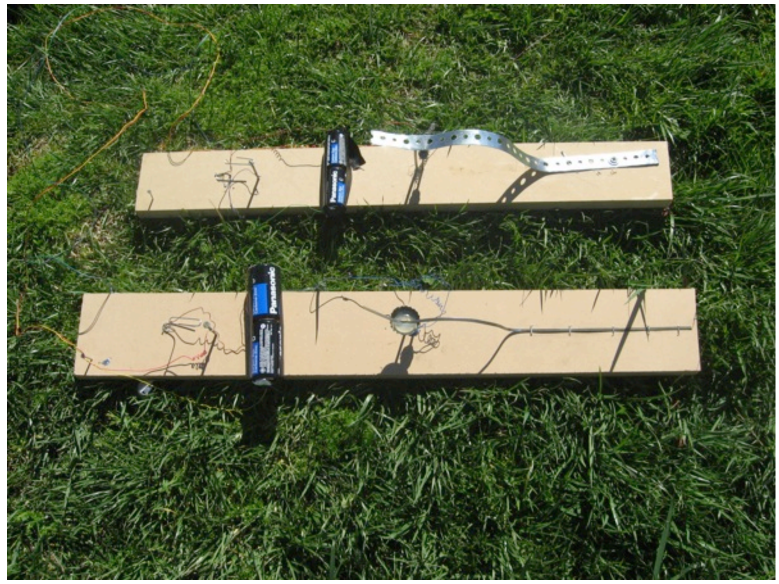
Telegraph

Category: Physics: Electricity & Magnetism

Type: Make & Take

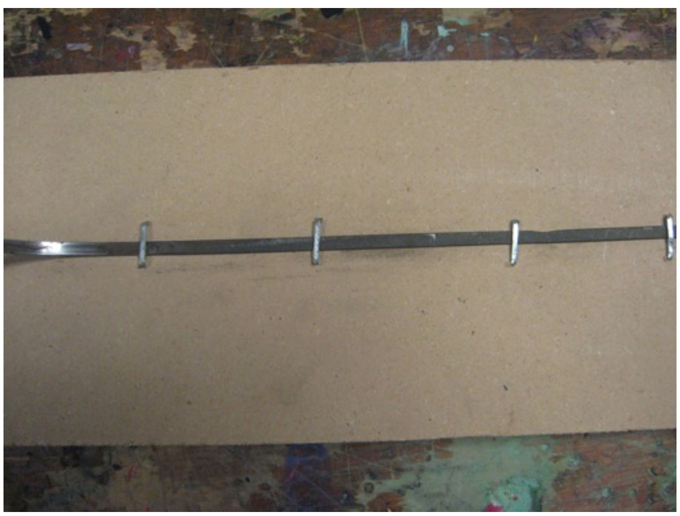


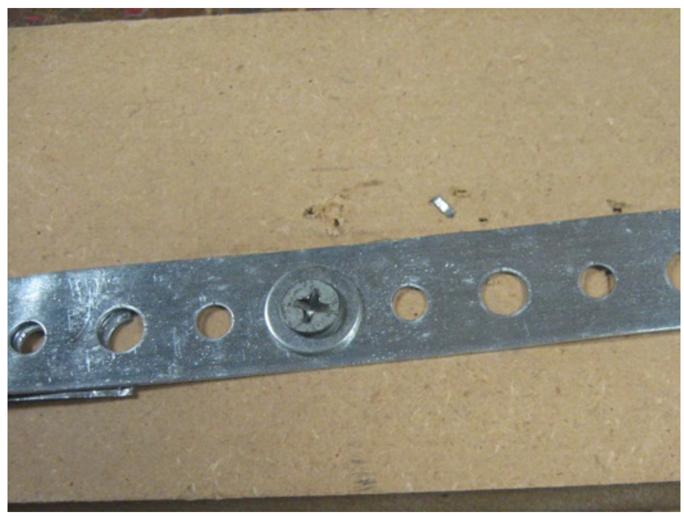
Rough Parts List:

2	Baseboards
2	Steel bristles from street sweeper or plumbers tape, 12"
12	Nails
2	Paperclips
2	Bottle caps
4	Batteries
4	Electrical wires
	Soldering iron
	Nail gun or washers and screws

Video: http://youtu.be/63H2neguOr4

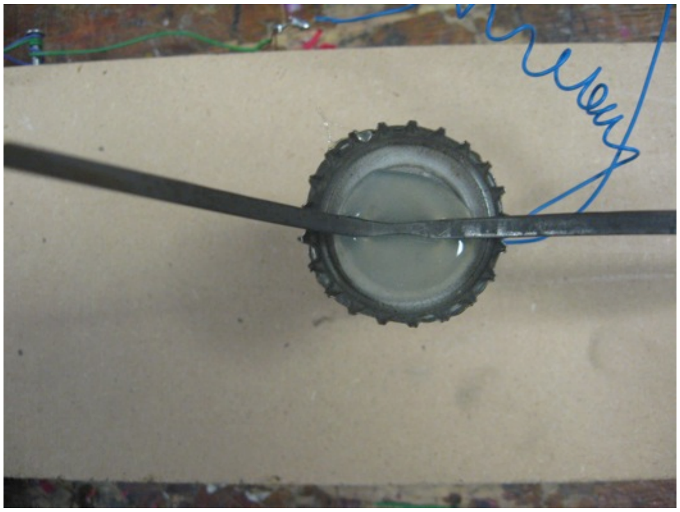
How To:



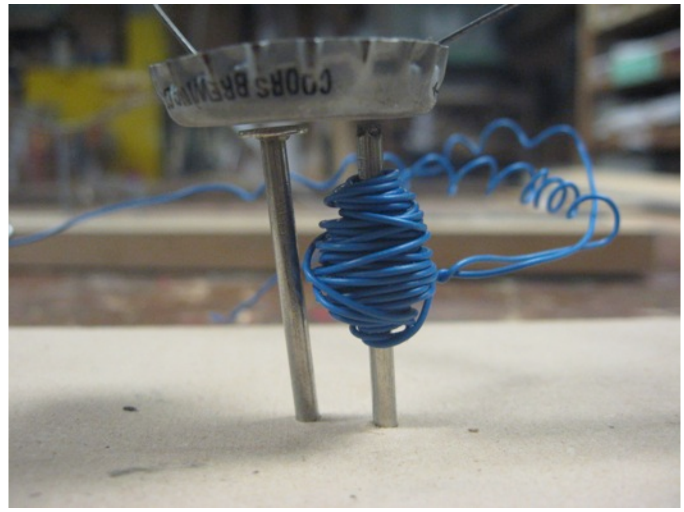


You can use either one of the parts shown. If you choose the street sweeper bristle, staple 2/3rd of the length of it to each baseboard.

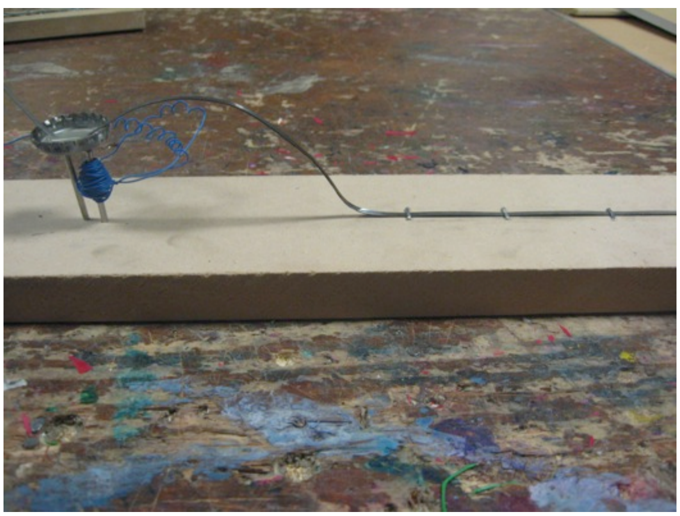
If using plumbers tape, use washers and screws to attach it to the baseboard.



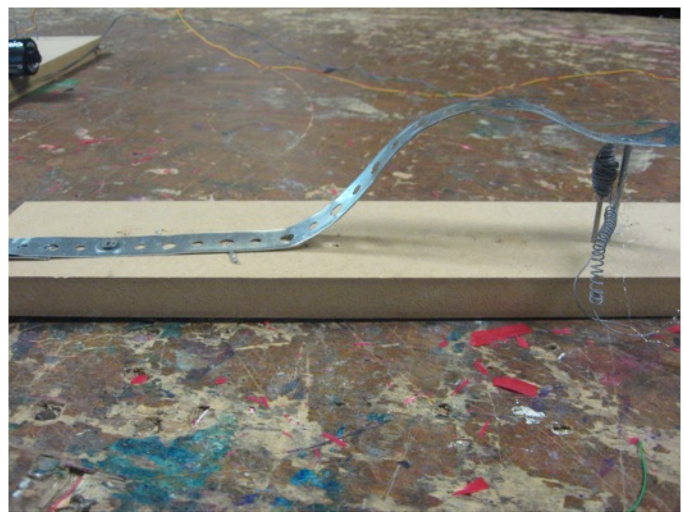
If using street sweeper bristle, glue a bottlecap onto the loose end of it.



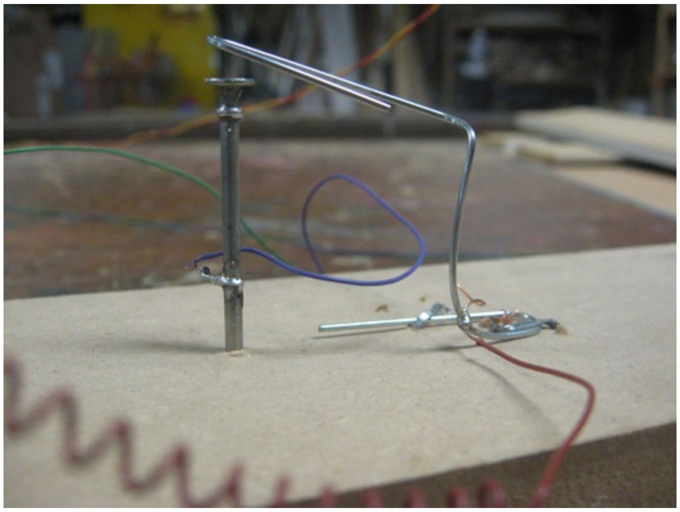
Hammer two nails into the baseboard. One nail should be slightly higher than the other. Do not worry about wiring the telegraph yet but remember that the shorter nail will be wrapped with electrical wire.

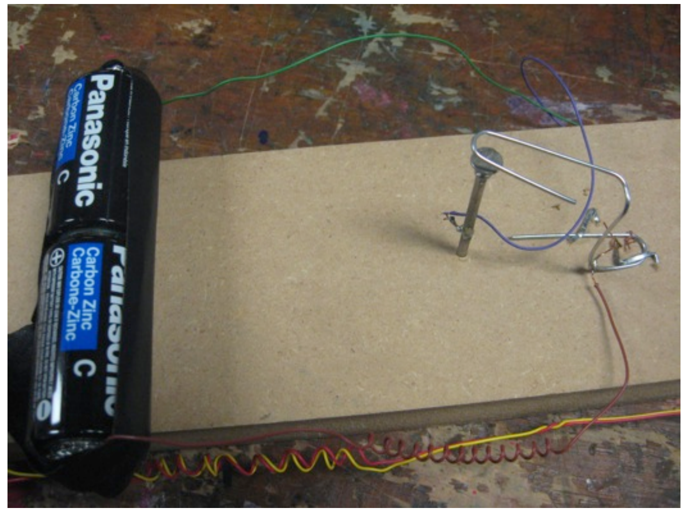


Shape the wire so that it arches away from the baseboard and back down towards the nails.



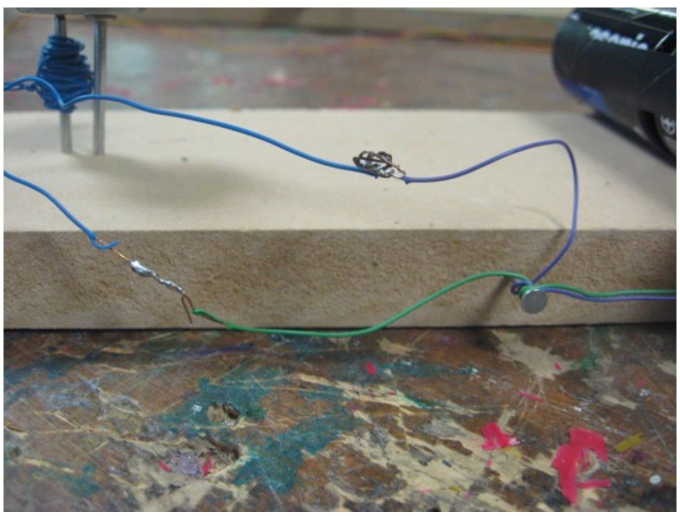
The wire should hover just above the higher nail. This part is the clicker.

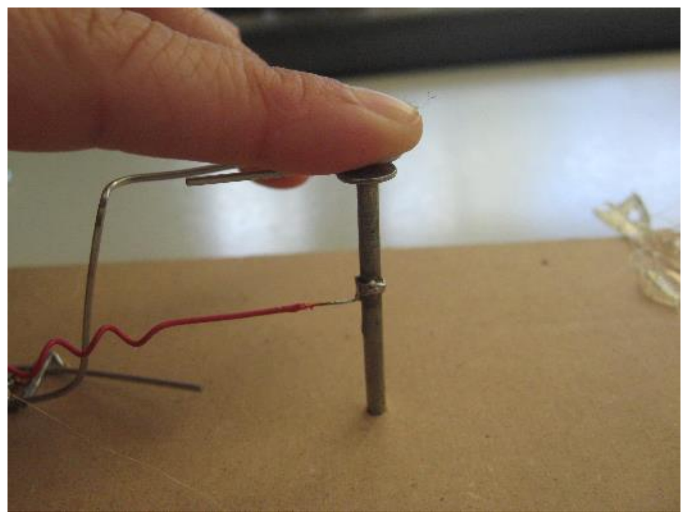




Hammer a nail into the other end of the board. Unbend a paperclip as pictured above. Staple or glue the paperclip so that it hovers just above the nail without touching it. This is the telegraph key.

Refer to the wiring diagram below to connect the electrical wires. Solder wires to the paper clips and nails for better connections.

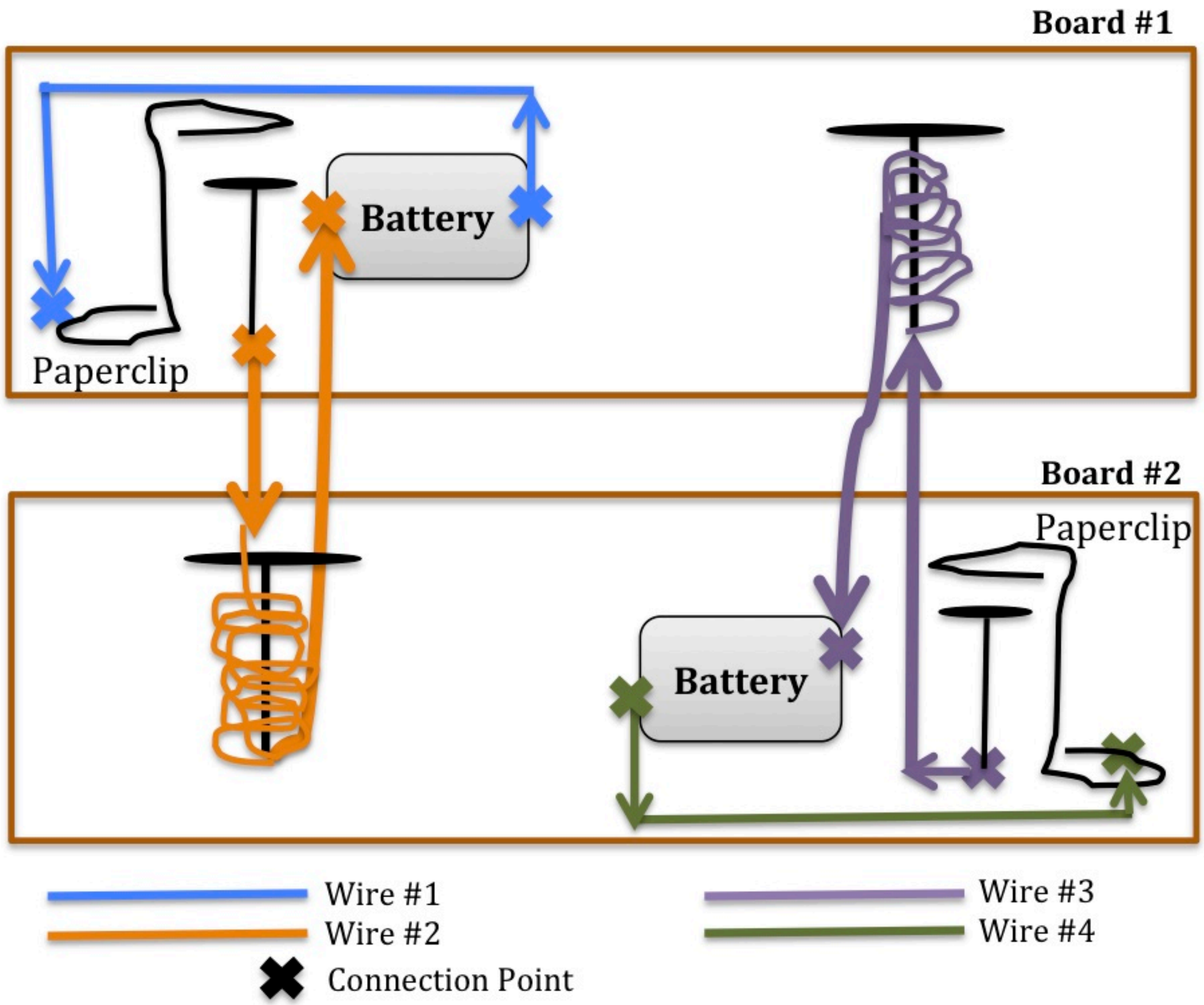




Hammer nails into the sides of the board to wrap and organize excess wire.

To send messages via telegraph, push the paperclip down to touch the nail. Everytime the two make contact, the street sweeper on the other board will move and contact the nails below it.

Wiring Diagram for Telegraph Set:



Fine Points:

→ We discovered that if we used one nail only on the clicker, the telegraph would stick to it even after we released the key, because the nail had become magnetized. To solve the problem, we use two nails: a longer one that hits the telegraph, and a shorter one that is wrapped with wire to become an electromagnet. When the circuit is activated, the electromagnet will attract the bottle cap or plumbers tape and the taller nail will stop the bottle cap but then not stick to it.

→ Adjust the street sweeper or plumbers tape so that it is close enough to the electromagnet that it will be pulled down by the electromagnet when the circuit is activated.

→ The more turns of wire you can wind around the nail, the stronger its magnetism will be and the better it will work.

Concepts Involved:

- Electromagnets only become magnetic when an electric current flows in a coil surrounding them.
- An electrical circuit is a complete path from a source, through some components, and back to the source.

Focus Questions:

1. How could you rewire the circuit so that the telegraph is made of only one board instead of two?
2. Could you wire 3 or 4 boards together?
3. Could you send messages from the two boards simultaneously?
4. What is the limit of how far this telegraph could send messages?

Elaboration:

Telegraphs were invented soon after the connection between electricity and magnetism was discovered in 1820. For around one hundred years from the 1830s to the 1930s, telegraphs were used for long-distance communication. Even after the invention of telephones, which can communicate sounds and speech using the same two wires of a telegraph system, telegraphs had the advantage of a clear, simple off/on signal that could be recorded easily, such as on a ticker-tape. Only the length of the wires and the strength of the signal limit the distance a telegraph message can be sent.

It was never a problem to get a signal running down a wire. The problem was to have some clear indication of the signal at the other end of a telegraph wire, an indication that could deliver a complex, coded message. Incandescent lights are tricky because they don't respond quickly and can burn out. The common solution was an electromagnet pulling on a piece of metal that would click when a signal arrived.

The code developed to go with the telegraph was the Morse code, a series of long and short signals – dots and dashes – linked to the letters of the alphabet. Around the world various other codes were used, some more efficient in transmitting information than the Morse code. Various machines were created to type out the dots and dashes or even type out the message, but a telegraph operator with experience could easily listen to the dots and dashes and understand the message.

The telegraph described here uses a paper clip and nail as the key. This is a simple switch, which makes and breaks the circuit. When the circuit is made complete, electricity flows through the wires wound around the nail and the nail becomes an electromagnet. This pulls down the bristle or plumber's tape until it clicks on the other nail.

You could connect the key right to its own clicker, but it wouldn't be very useful for communication. You could connect multiple clickers to a single key, and in fact many telegraph offices would receive the information that may be just for one destination. On this model you can send and receive at the same time, because you've got four wires connecting the two units. If there were only two wires, you would have to have some system to connect and disconnect the key and clicker depending on whether you are sending or receiving.

Links to k-12 California Content Standards:

Grades k-8 Standard Set Investigation and Experimentation

Scientific progress is made by asking meaningful questions and conducting careful investigations. As a basis for understanding this concept and addressing the content in the other strands, students should develop their own questions and perform investigations.

Grades k-12 Mathematical Reasoning:

1.0 Students make decisions about how to approach problems:

1.1 Analyze problems by identifying relationships, distinguishing relevant from irrelevant information,

sequencing and prioritizing information, and observing patterns.
1.2 Determine when and how to break a problem into simpler parts.

2.0 Students use strategies, skills, and concepts in finding solutions:
2.1 Use estimation to verify the reasonableness of calculated results.
2.2 Apply strategies and results from simpler problems to more complex problems.
2.3 Use a variety of methods, such as words, numbers, symbols, charts, graphs, tables, diagrams, and models, to explain mathematical reasoning.
2.5 Indicate the relative advantages of exact and approximate solutions to problems and give answers to a specified degree of accuracy.

3.0 Students move beyond a particular problem by generalizing to other situations:
3.1 Evaluate the reasonableness of the solution in the context of the original situation.
3.2 Note the method of deriving the solution and demonstrate a conceptual understanding of the derivation by solving similar problems.
3.3 Develop generalizations of the results obtained and apply them in other circumstances.

<u>Grade 3 Standard Set 1. Physical Sciences (Energy & Matter):</u>
1.d Students know energy can be carried from one place to another by waves, such as water waves and sound waves, by electric current, and by moving objects.

<u>Grade 4 Standard Set 1. Physical Sciences</u>
Electricity and magnetism are related effects that have many useful applications in everyday life.
1.c Students know electric currents produce magnetic fields and know how to build a simple electromagnet.